

Appendix M to Part 121—Airplane Flight Recorder Specifications**↑** [top](#)

The recorded values must meet the designated range, resolution, and accuracy requirements during dynamic and static conditions. All data recorded must be correlated in time to within one second.

Parameters	Range	Accuracy (sensor input)	Seconds per sampling interval	Resolution	Remarks
1. Time or Relative Times Counts. ¹	24 Hrs, 0 to 4095	$\pm 0.125\%$ Per Hour	4	1 sec	UTC time preferred when available. Count increments each 4 second of system operation.
2. Pressure Altitude	-1000 ft to max certificated altitude of aircraft. +5000 ft	± 100 to ± 700 ft (see table, TSO C124a or TSO C51a)	1	5' to 35'	Data should be obtained from the air data computer when practicable.
3. Indicated airspeed or Calibrated airspeed	50 KIAS or minimum value to Max V_{so} to 1.2 V_D	$\pm 5\%$ and $\pm 3\%$	1	1 kt	Data should be obtained from the air data computer when practicable.
4. Heading (Primary flight crew reference)	0–360° and Discrete “true” or “mag”	$\pm 2^\circ$	1	0.5°	When true or magnetic heading can be selected as the primary heading reference, a discrete indicating selection must be recorded.
5. Normal acceleration (vertical) ⁹	-3g to +6g	$\pm 1\%$ of max range excluding datum error of $\pm 5\%$	0.125	0.004g	
6. Pitch Attitude	$\pm 75^\circ$	$\pm 2^\circ$	1 or 0.25 for airplanes operated under	0.5°	A sampling rate of 0.25 is recommended.

			§121.344(f)		
7. Roll attitude ²	±180°	±2°	1 or 0.5 for airplanes operated under §121.344(f)	0.5	A sampling rate of 0.5 is recommended.
8. Manual Radio Transmitter Keying or CVR/DFDR synchronization reference	On-Off (Discrete) None		1		Preferably each crew member but one discrete acceptable for all transmission provided the CVR/FDR system complies with TSO C124a CVR synchronization requirements (paragraph 4.2.1 ED-55).
9. Thrust/power on each engine—primary flight crew reference	Full range forward	±2%	1 (per engine)	0.3% of full range	Sufficient parameters (e.g. EPR, N1 or Torque, NP) as appropriate to the particular engine being recorded to determine power in forward and reverse thrust, including potential overspeed condition.
10. Autopilot Engagement	Discrete “on” or “off”		1		
11. Longitudinal Acceleration	±1g	±1.5% max. range excluding datum error of ±5%	0.25	0.004g	
12a. Pitch Control(s) position (non-fly-by-wire systems)	Full Range	±2° Unless Higher Accuracy	0.5 or 0.25 for airplanes operated under	0.5% of full range	For airplanes that have a flight control break

		Uniquely Required	§121.344(f)		away capability that allows either pilot to operate the controls independently, record both control inputs. The control inputs may be sampled alternately once per second to produce the sampling interval of 0.5 or 0.25, as applicable.
12b. Pitch Control(s) position (fly-by-wire systems). ³	Full Range	$\pm 2^\circ$ Unless Higher Accuracy Uniquely Required.	0.5 or 0.25 for airplanes operated under §121.344(f).	0.2% of full range	
13a. Lateral Control position(s) (non-fly-by-wire)	Full Range	$\pm 2^\circ$ Unless Higher Accuracy Uniquely Required	0.5 or 0.25 for airplanes operated under §121.344(f)	0.2% of full range	For airplanes that have a flight control break away capability that allows either pilot to operate the controls independently, record both control inputs. The control inputs may be sampled alternately once per second to produce the sampling interval of 0.5 or 0.25, as applicable.
13b. Lateral Control position(s) (fly-by-wire). ⁴	Full Range	$\pm 2^\circ$ Unless Higher Accuracy Uniquely Required	0.5 or 0.25 for airplanes operated under §121.344(f)	0.2% of full range	
14a. Yaw control position(s)	Full range	$\pm 2^\circ$ Unless	0.5	0.3% of	For airplanes that

(non-fly-by-wire) ⁵		higher accuracy uniquely required		full range	have a flight control break away capability that allows either pilot to operate the controls independently, record both control inputs. The control inputs may be sampled alternately once per second to produce the sampling interval of 0.5.
14b. Yaw Control position(s) (fly-by-wire)	Full Range	$\pm 2^\circ$ Unless Higher Accuracy Uniquely Required	0.5	0.2% of full range	
15. Pitch Control Surface(s) Position. ⁶	Full Range	$\pm 2^\circ$ Unless Higher Accuracy Uniquely Required.	0.5 or 0.25 for airplanes operated under §121.344(f).	0.3% of full range.	For airplanes fitted with multiple or split surfaces, a suitable combination of inputs is acceptable in lieu of recording each surface separately. The control surfaces may be sampled alternately to produce the sampling interval of 0.5 or 0.25.
16. Lateral control surface(s) position ⁷	Full range	$\pm 2^\circ$ Unless higher accuracy uniquely required	0.5 or 0.25 for airplanes operated under §121.344(f)	0.3% of full range	A suitable combination of surface position sensors is acceptable in lieu of recording each

					surface separately. The control surfaces may be sampled alternately to produce the sampling interval of 0.5 or 0.25.
17. Yaw Control Surface(s) Position. ⁸	Full Range	$\pm 2^\circ$ Unless Higher Accuracy Uniquely Required	0.5	0.2% of full range	For airplanes with multiple or split surfaces, a suitable combination of surface position sensors is acceptable in lieu of recording each surface separately. The control surfaces may be sampled alternately to produce the sampling interval of 0.5.
18. Lateral Acceleration	$\pm 1g$	$\pm 1.5\%$ max. range excluding datum error of $\pm 5\%$	0.25	0.004g	
19. Pitch Trim Surface Position	Full Range	$\pm 3^\circ$ Unless Higher Accuracy Uniquely Required	1	0.6% of full range	
20. Trailing Edge Flap or Cockpit Control Selection. ¹⁰	Full Range or Each Position (discrete)	$\pm 3^\circ$ or as Pilot's indicator	2	0.5% of full range	Flap position and cockpit control may each be sampled at 4 second intervals, to give a data point every 2 seconds.

21. Leading Edge Flap or Cockpit Control Selection. ¹¹	Full Range or Each Discrete Position	$\pm 3^\circ$ or as Pilot's indicator and sufficient to determine each discrete position	2	0.5% of full range	Left and right sides, or flap position and cockpit control may each be sampled at 4 second intervals, so as to give a data point every 2 seconds.
22. Each Thrust Reverser Position (or equivalent for propeller airplane)	Stowed, In Transit, and Reverse (Discrete)		1 (per engine)		Turbo-jet—2 discretes enable the 3 states to be determined. Turbo-prop—discrete.
23. Ground spoiler position or brake selection ¹²	Full range or each position (discrete)	$\pm 2^\circ$ Unless higher accuracy uniquely required	1 or 0.5 for airplanes operated under §121.344(f)	0.5% of full range	
24. Outside Air Temperature or Total Air Temperature. ¹³	-50°C to $+90^\circ\text{C}$	$\pm 2^\circ\text{C}$	2	0.3°C	
25. Autopilot/Autothrottle/AFCS Mode and Engagement Status	A suitable combination of discretes		1		Discretes should show which systems are engaged and which primary modes are controlling the flight path and speed of the aircraft.
26. Radio Altitude ¹⁴	-20 ft to $2,500\text{ ft}$	$\pm 2\text{ ft}$ or $\pm 3\%$ whichever is greater below 500 ft and $\pm 5\%$ above 500 ft	1	$1\text{ ft} + 5\%$ above 500 ft	For autoland/category 3 operations. Each radio altimeter should be recorded, but arranged so that at least one is recorded each second.

27. Localizer Deviation, MLS Azimuth, or GPS Latitude Deviation	± 400 Microamps or available sensor range as installed $\pm 62^\circ$	As installed $\pm 3\%$ recommended	1	0.3% of full range	For autoland/category 3 operations. Each system should be recorded but arranged so that at least one is recorded each second. It is not necessary to record ILS and MLS at the same time, only the approach aid in use need be recorded.
28. Glideslope Deviation, MLS Elevation, or GPS Vertical Deviation	± 400 Microamps or available sensor range as installed 0.9 to $+30^\circ$	As installed $+3-3\%$ recommended	1	0.3% of full range	For autoland/category 3 operations. Each system should be recorded but arranged so that at least one is recorded each second. It is not necessary to record ILS and MLS at the same time, only the approach aid in use need be recorded.
29. Marker Beacon Passage	Discrete "on" or "off"		1		A single discrete is acceptable for all markers.
30. Master Warning	Discrete		1		Record the master warning and record each "red" warning that cannot be determined from other parameters

					or from the cockpit voice recorder.
31. Air/ground sensor (primary airplane system reference nose or main gear)	Discrete "air" or "ground"		1 (0.25 recommended)		
32. Angle of Attack (If measured directly)	As installed	As installed	2 or 0.5 for airplanes operated under §121.344(f)	0.3% of full range	If left and right sensors are available, each may be recorded at 4 or 1 second intervals, as appropriate, so as to give a data point at 2 seconds or 0.5 second, as required.
33. Hydraulic Pressure Low, Each System	Discrete or available sensor range, "low" or "normal"	±5%	2	0.5% of full range	
34. Groundspeed	As Installed	Most Accurate Systems Installed	1	0.2% of full range	
35. GPWS (ground proximity warning system)	Discrete "warning" or "off"		1		A suitable combination of discretes unless recorder capacity is limited in which case a single discrete for all modes is acceptable.
36. Landing Gear Position or Landing gear cockpit control selection	Discrete		4		A suitable combination of discretes should be recorded.
37. Drift Angle. ¹⁵	As installed	As installed	4	0.1°	
38. Wind Speed and	As installed	As installed	4	1 knot, and	

Direction				1.0°	
39. Latitude and Longitude	As installed	As installed	4	0.002°, or as installed	Provided by the Primary Navigation System Reference. Where capacity permits Latitude/longitude resolution should be 0.0002°.
40. Stick shaker and pusher activation	Discrete(s) "on" or "off"		1		A suitable combination of discretes to determine activation.
41. Windshear Detection	Discrete "warning" or "off"		1		
42. Throttle/power Lever position. ¹⁶	Full Range	±2%	1 for each lever	2% of full range	For airplanes with non-mechanically linked cockpit engine controls.
43. Additional Engine Parameters	As installed	As installed	Each engine each second	2% of full range	Where capacity permits, the preferred priority is indicated vibration level, N2, EGT, Fuel Flow, Fuel Cut-off lever position and N3, unless engine manufacturer recommends otherwise.
44. Traffic Alert and Collision Avoidance System (TCAS)	Discretes	As installed	1		A suitable combination of discretes should be recorded to determine the status of— Combined Control, Vertical

					Control, Up Advisory, and Down Advisory. (ref. ARINC Characteristic 735 Attachment 6E, TCAS VERTICAL RA DATA OUTPUT WORD.)
45. DME 1 and 2 Distance	0–200 NM	As installed	4	1 NM	1 mile
46. Nav 1 and 2 Selected Frequency	Full Range	As installed	4		Sufficient to determine selected frequency
47. Selected barometric setting	Full Range	±5%	(1 per 64 sec.)	0.2% of full range	
48. Selected Altitude	Full Range	±5%	1	100 ft	
49. Selected speed	Full Range	±5%	1	1 knot	
50. Selected Mach	Full Range	±5%	1	.01	
51. Selected vertical speed	Full Range	±5%	1	100 ft/min	
52. Selected heading	Full Range	±5%	1	1°	
53. Selected flight path	Full Range	±5%	1	1°	
54. Selected decision height	Full Range	±5%	64	1 ft	
55. EFIS display format	Discrete(s)		4		Discretes should show the display system status (e.g., off, normal, fail, composite, sector, plan, nav aids, weather radar, range, copy.
56. Multi-function/Engine Alerts Display format	Discrete(s)		4		Discretes should show the display system status (e.g., off, normal, fail, and the identity of display pages for

					emergency procedures, need not be recorded.
57. Thrust command. ¹⁷	Full Range	±2%	2	2% of full range	
58. Thrust target	Full Range	±2%	4	2% of full range	
59. Fuel quantity in CG trim tank	Full Range	±5%	(1 per 64 sec.)	1% of full range	
60. Primary Navigation System Reference	Discrete GPS, INS, VOR/DME, MLS, Loran C, Omega, Localizer Glideslope		4		A suitable combination of discretes to determine the Primary Navigation System reference.
61. Ice Detection	Discrete “ice” or “no ice”		4		
62. Engine warning each engine vibration	Discrete		1		
63. Engine warning each engine over temp	Discrete		1		
64. Engine warning each engine oil pressure low	Discrete		1		
65. Engine warning each engine over speed	Discrete		1		
66. Yaw Trim Surface Position	Full Range	±3% Unless Higher Accuracy Uniquely Required	2	0.3% of full range	
67. Roll Trim Surface Position	Full Range	±3% Unless Higher Accuracy Uniquely Required	2	0.3% of full range	
68. Brake Pressure (left and right)	As installed	±5%	1		To determine braking effort applied by pilots

					or by autobrakes.
69. Brake Pedal Application (left and right)	Discrete or Analog “applied” or “off”	±5% (Analog)	1		To determine braking applied by pilots.
70. Yaw or sideslip angle	Full Range	±5%	1	0.5°	
71. Engine bleed valve position	Discrete “open” or “closed”		4		
72. De-icing or anti-icing system selection	Discrete “on” or “off”		4		
73. Computed center of gravity	Full Range	±5%	(1 per 64 sec.)	1% of full range	
74. AC electrical bus status	Discrete “power” or “off”		4		Each bus.
75. DC electrical bus status	Discrete “power” or “off”		4		Each bus.
76 APU bleed valve position	Discrete “open” or “closed”		4		
77. Hydraulic Pressure (each system)	Full range	±5%	2	100 psi	
78. Loss of cabin pressure	Discrete “loss” or “normal”		1		
79. Computer failure (critical flight and engine control systems)	Discrete “fail” or “normal”		4		
80. Heads-up display (when an information source is installed)	Discrete(s) “on” or “off”		4		
81. Para-visual display (when an information source is installed)	Discrete(s) “on” or “off”				
82. Cockpit trim control input position—pitch	Full Range	±5%	1	0.2% of full range	Where mechanical means

					for control inputs are not available, cockpit display trim positions should be recorded.
83. Cockpit trim control input position—roll	Full Range	$\pm 5\%$	1	0.7% of full range	Where mechanical means for control inputs are not available, cockpit display trim position should be recorded.
84. Cockpit trim control input position—yaw	Full range	$\pm 5\%$	1	0.3% of full range	Where mechanical means for control input are not available, cockpit display trim positions should be recorded.
85. Trailing edge flap and cockpit flap control position	Full Range	$\pm 5\%$	2	0.5% of full range	Trailing edge flaps and cockpit flap control position may each be sampled alternately at 4 second intervals to provide a sample each 0.5 second.
86. Leading edge flap and cockpit flap control position	Full Range or Discrete	$\pm 5\%$	1	0.5% of full range	
87. Ground spoiler position and speed brake selection	Full range or discrete	$\pm 5\%$	0.5	0.3% of full range	
88. All cockpit flight control input forces (control wheel, control column, rudder pedal)	Full range control wheel ± 70 lb control column ± 85 rudder pedal ± 165	$\pm 5\%$	1	0.3% full range	For fly-by-wire flight control systems, where flight control surface position is a function of the displacement of

					the control input device only, it is not necessary to record this parameter. For airplanes that have a flight control break away). capability that allows either pilot to operate the control independently, record both control force inputs. The control force inputs may be sampled alternately once per 2 seconds to produce the sampling interval of 1.
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¹For A300 B2/B4 airplanes, resolution=6 seconds.

²For A330/A340 series airplanes, resolution=0.703°.

³For A318/A319/A320/A321 series airplanes, resolution=0.275% (0.088°>0.064°).

For A330/A340 series airplanes, resolution=2.20%(0.703°>0.064°).

⁴For A318/A319/A320/A321 series airplanes, resolution=0.22% (0.088°>0.080°).

For A330/A340 series airplanes, resolution=1.76% (0.703°>0.080°).

⁵For A330/A340 series airplanes, resolution = 1.18% (0.703°>0.120°).

⁶For A330/A340 series airplanes, resolution=0.783% (0.352°>0.090°).

⁷For A330/A340 series airplanes, aileron resolution = 0.704% (0.352°>0.100°). For A330/A340 series airplanes, spoiler resolution = 1.406% (0.703°>0.100°).

⁸For A330/A340 series airplanes, resolution=0.30% (0.176°>0.12°).

For A330/A340 series airplanes, seconds per sampling interval=1.

⁹For B-717 series airplanes, resolution = .005g. For Dassault F900C/F900EX airplanes, resolution = .007g.

¹⁰For A330/A340 series airplanes, resolution≠1.05% (0.250°>0.120°).

¹¹For A330/A340 series airplanes, resolution = 1.05% (0.250°>0.120°). For A300 B2/B4 series airplanes, resolution = 0.92% (0.230°>0.125°).

¹²For A330/A340 series airplanes, spoiler resolution = 1.406% (0.703° > 0.100°).

¹³For A330/A340 series airplanes, resolution = 0.5°C.

¹⁴For Dassault F900C/F900EX airplanes, Radio altitude resolution = 1.25 ft.

¹⁵For A330/A340 series airplanes, resolution = 0.352 degrees.

¹⁶For A318/A319/A320/A321 series airplanes, resolution = 4.32%. For A330/A340 series airplanes, resolution is 3.27% of full range for throttle lever angle (TLA); for reverse thrust, reverse throttle lever angle (RLA) resolution is nonlinear over the active reverse thrust range, which is 51.54 degrees to 96.14 degrees. The resolved element is 2.8 degrees uniformly over the entire active reverse thrust range, or 2.9% of the full range value of 96.14 degrees.

¹⁷For A318/A319/A320/A321 series airplanes, with IAE engines, resolution = 2.58%.

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